GUARDRAIL

INTEROFFICE MEMO

TECHNICAL SERVICES
Roadway Engineering Section
Office Phone: (503) 986-3714
Fax Number: (503) 986-3749

DATE: October 29, 2003

TO: Designers, Transportation Design Managers, and Memos to Designers Manual Holders

FROM: Thomas J. Lauer, P.E.
Roadway Engineering Manager

SUBJECT: Guardrail Terminals

This memo is to modify guardrail terminal policy.

HISTORY:

In January 1999 a memo was sent out outlining the criteria for selecting among the myriad of choices available for guardrail terminals. Direction was given to try to install the greatest "W" offset terminal possible. Recognition was made that, when there might be an environmental concern or right-of-way concern regarding construction of paved flares, the designer could opt for a non-flared terminal, provided the Standards Engineer was advised. It appears now that these above-mentioned instances are becoming regular occurrences so we see a need to adjust policy.

NEW POLICY:

- Non-flared guardrail terminals are considered appropriate on any facility where 1.8 m paved shoulder clearance in front of the guardrail exists or can be achieved.
- If a terminal is being replaced and there exists a paved flare, it is acceptable to use the existing footprint of the paved flare, as long as Length of Need is adequate according to the latest publication of the Roadside Design Guide.
- The design of new 2.49-m wide flares on any facility is not recommended.
- Care should be used in the application of non-flared terminals in snow zone sections. Use of non-flared terminals in areas where snow poles are commonly used or where snow pack routinely obscures the guardrail section may result in a high frequency of snowplow damage to the terminals.

When situations arise that require exception to one of the above-stated guidelines, the designer must consult with the Standards Engineer so it can be dealt with on a case-by-case basis.

INTEROFFICE MEMO

TECHNICAL SERVICES BRANCH
Roadway Engineering Section
Office Phone: (503) 986-3714
Fax Phone: (503) 986-3749

March 22, 1999

File Code: PRO 5-1

TO: Designers, Roadway Design Supervisors & Specifications

FROM: Daniel MacDonald
Standards Engineer

SUBJECT: Guardrail End Terminals

Due out soon is a set of revised guardrail standard drawings. The significant change occurs in RD 416, RD 417, and RD 420, where the paved taper return rate has been steepened from 15: 1 to 10: 1. The 15: 1 taper rate, introduced in December 1998, proved to be too long for implementing on jobs. Also changed, on the same three drawings, are the flat distances required between the face of rail and the break point behind at the first post. Now, there is no difference in distance between the two types of terminals shown on RD 417. We hope that these changes enable us to put out a consistent constructible design of guardrail that meets requirements of NCHRP 350 Report.

Attached is information regarding a new acceptable guardrail end terminal product and one terminal that has been dropped from the Qualified Products List. This is to supplement the document sent January 15, 1999.

Feel free to contact me at (503) 986-3779 if you have questions regarding guardrail end terminals.

FILE UNDER: Letters to Designers, Part 12, Guardrail

DM:plg

Attachment

cc: Ken Stoneman, w/attach.
Cathy Nelson, w/ attach.
Mark Hirota, w/ attach.
Dale Deatherage, w/ attach.

Mike Dunning, w/ attach.
Region Construction Engineers, w/ attach.
District Maintenance Supervisors, w/ attach.
Project Managers, w/ attach.
Tori Kinne, FHWA, w/ attach.

GUARDRAIL END TERMINALS
March 1999

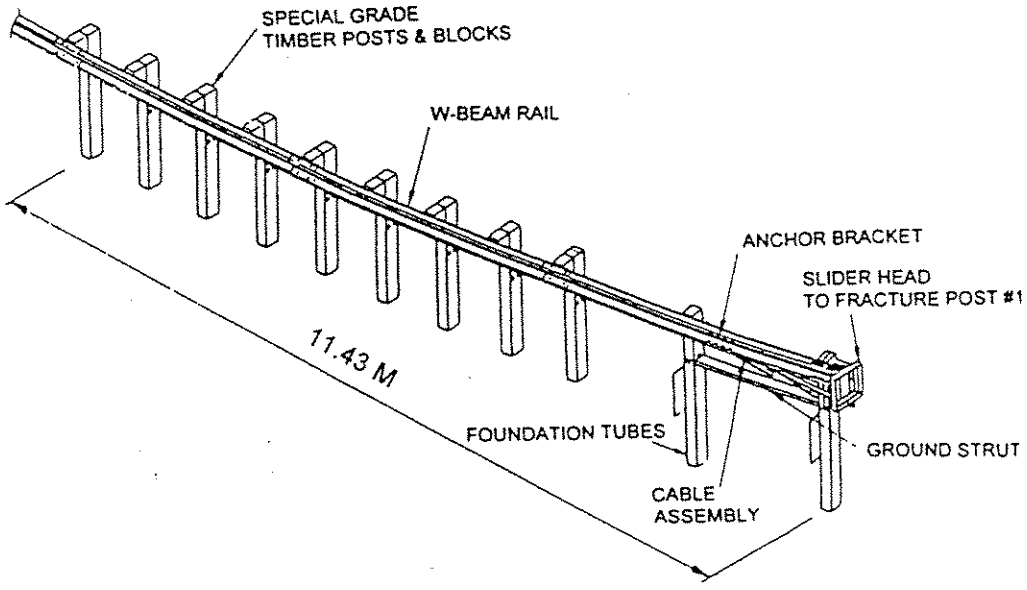
The BEST brand guardrail terminal described in the January 15, 1999 document has been removed form the Qualified Products List. The SKT-350 terminal, also described in the document is a near duplicate of the BEST, manufactured by the same company who admits that the SKT-350 is a better product.

A new flared terminal has been added to the QPL.

- **REGENT**
  Type: Parabolic flare, width 1.22 m
  Length: 11.43 m
  Posts: 10
  Energy absorption: Rail buckles

  See Figure C, attached

REGENT



FLARED TERMINALS

Figure C

INTEROFFICE MEMO

TECHNICAL SERVICES BRANCH
Roadway Engineering Section
Office Phone: (503) 986-3714
Fax Phone: (503) 986-3749

DATE: January 15, 1999

TO: Designers, Roadway Design Supervisors & Specifications

FROM: Daniel MacDonald
Standards Engineer

SUBJECT: Guardrail End Terminals

Attached is information regarding current acceptable guardrail end terminals, including design and selection criteria.

This document describes the guardrail end terminal systems that are now available and recorded on the current Qualified Products List. There are other systems that may be available in the future but have not yet been approved.

Feel free to contact me at (503) 986-3779 if you have questions regarding guardrail end terminals.

DM:csw

Attachment

cc: Ken Stoneman, w/attach.
Cathy Nelson, w/ attach.
Mark Hirota, w/ attach.
Dale Deatherage, w/ attach.
Mike Dunning, w/ attach.
Region Construction Engineers, w/ attach.
District Maintenance Managers, w/ attach.
Project Managers, w/ attach.
Tori Kinne, FHWA, w/ attach.

GUARDRAIL END TERMINALS

January 1999

1. Guardrail End Terminals

Guardrail end terminals are protective systems that prevent errant vehicles from impacting hazards, by either gradually decelerating the vehicle to a stop when hit head-on, or by redirecting the vehicle away from the hazard when struck on the side. These systems are connected to the ends of runs of guardrail and work in concert with the guardrail run to shield rigid objects or hazardous conditions that cannot be removed, relocated, or made break-away.

All end terminals utilize W-Beam rail and breakaway timber posts, which are set in steel foundation tubes for ease of replacement. All systems establish the third post from the end as length-of-need point, referred to in the Roadside Design Guide.

Approved end terminals are shown on Figures A & B and are described as follows:

- **SKT-350**
  Type: non-flared
  Length: 15.24 m
  Posts: 8
  Energy absorption: Extruder head kinks rail element

- **ET-2000**
  Type: non-flared
  Length: 15.24 m
  Posts: 8
  Energy absorption: Extruder head flattens rail element

- **LET**
  Type: non-flared
  Length: 11.43 m
  Posts: 7
  Energy absorption: Extruder head flattens rail element

- **BEST**
  Type: non-flared
  Length: 11.43 m
  Posts: 7
  Energy absorption: Head cuts rail element

- **FLEAT**
  Type: Straight flare, width variable 0.76 m – 1.22 m
  Length: 11.43 m
  Posts: 7
  Energy absorption: Extruder head kinks rail element

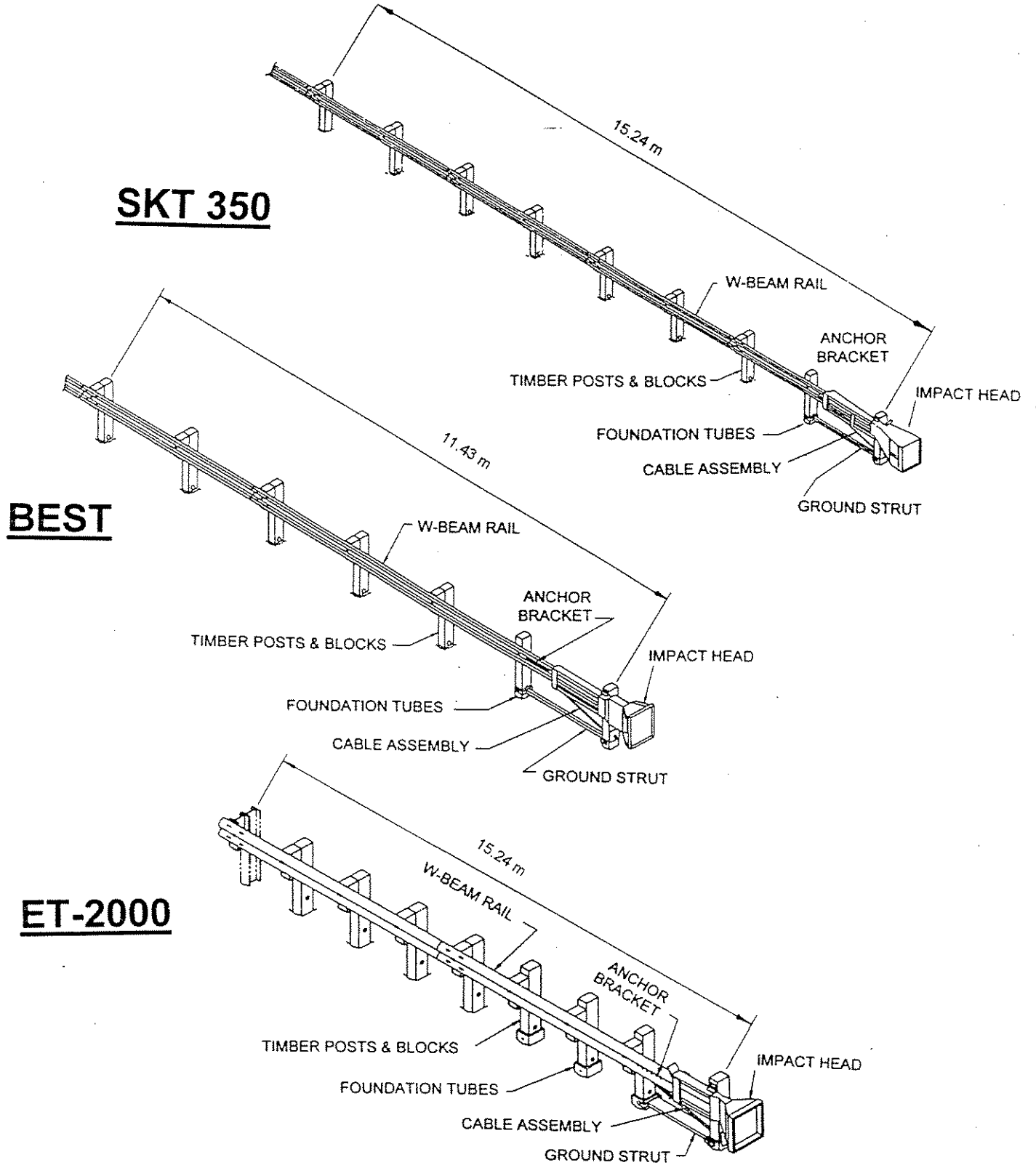
- **SRT-350**
  Type: Parabolic flare, width 1.22 m
  Length: 11.43 m
  Posts: 9 or 10
  Energy absorption: Rail buckles

2. Design Criteria

As noted above there now are variable guardrail terminals that can be considered. Of primary importance is that the probability of a vehicle impacting the end of the terminal must be minimized. A terminal end placed 2.49 m off the normal edge of pavement is less likely to be head-on impacted than a terminal placed at the edge of pavement.

Use the 2.49 m flare on interstate projects and on other projects where feasible. If geometric constraints make it impossible or impracticable to use a 2.49 m flare use the 1.22 m flare. If there are further constaints against specifying a 1.22 m flare, consider a reduced flare. The FLEAT terminal is a straight flare that can be reduced down to 0.76 m offset. If there are still constraints the last option to consider is the non-flared terminal. Specifying any flare with an offset less than 1.22 m requires approval of the Standards Engineer. Do not base justification for use of a reduced or non-flared terminal solely on cost difference of embankment construction. Replacement costs of terminals will override initial cost differences if the hit frequency is increased.

On all construction notes on the plans, specify the 'W' dimension, as has always been done. If a non-flared terminal has been selected, then the designer now must also specify the length of the terminal, since the four approved non-flared terminals are available in two lengths. Note that the length of need of a non-flared terminal is one rail length (3.81 m) longer than that of a 1.22 m flare, due to the third post from the end being closer to the roadway.

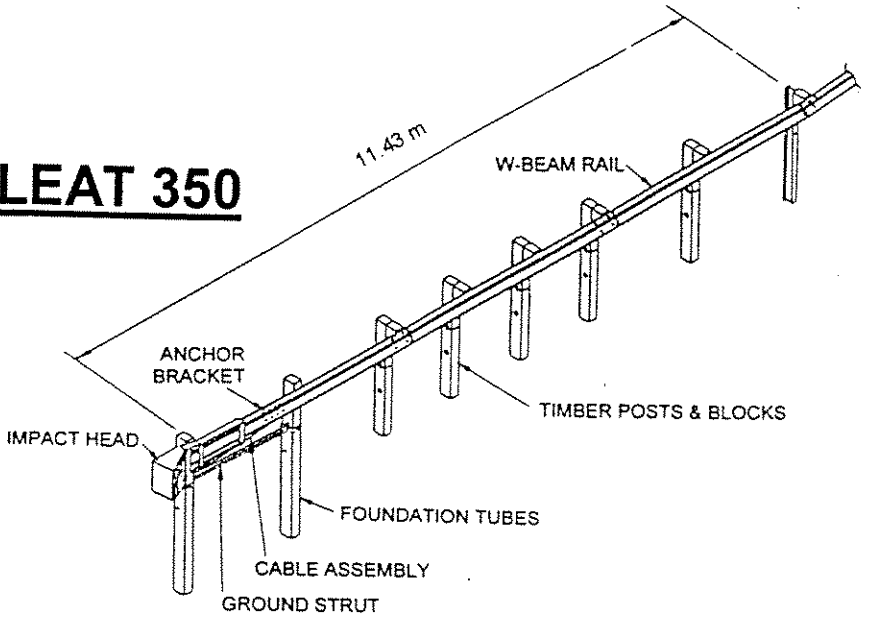


LET Same as ET-2000 with 11.43 m length

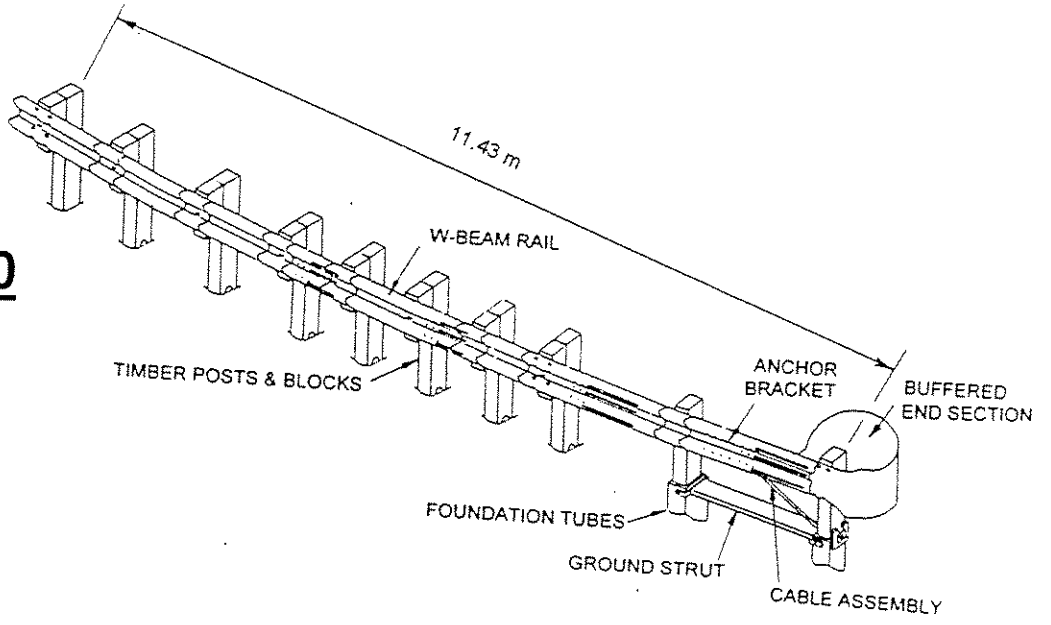
NON-FLARED TERMINALS

Figure A

FLEAT 350



SRT 350



FLARED TERMINALS

Figure

INTEROFFICE MEMO

TECHNICAL SERVICES BRANCH
Administrative Management Section
Office Phone: (503) 986-3479
Fax Phone: (503) 986-3749

December 8, 1998

TO: Designers
Specifications

FROM: Daniel MacDonald
Standards Engineer

SUBJECT: Guardrail

Industry has flooded the market lately with a new line of crash tested guardrail end terminals. They now have been added to our Qualified Products List. The policy of ODOT the last few years was to specify the Slotted Rail Terminal – 350 only as a bid item. That term is proprietary and we cannot specify it any longer. Change to a generic item "Guardrail Terminal, Flared" or "Guardrail Terminal, Non-flared" as named bid items. Change the line in the construction note also, to reflect the new term.

There is a publication of updated standard drawings due soon that will show these changes described above. Also included are two new drawings, RD 416 and RD 417, which were created to show the layout of flared and non-flared terminals. For the standard 1.22 m flare use the earthwork requirement for the parabolic flare. Note also that the non-flared terminal still requires some embankment constructed behind the rail.

This change will be effective with the February, 1999 letting.

FILE UNDER: Letters To Designers, Part 12, Guardrail

DM:csw

Cc: Project Managers
Cathy Nelson
Keith Johnston
Mike Dunning

Oregon

INTEROFFICE MEMO

Roadway Engineering Section

DATE: May 23, 1995

TO: Roadway Designers, Roadway Design Supervisors, Specifications

FROM: Sam Johnston
Standards Engineer

SUBJECT: Guard Rail End Terminals

As a result of an FHWA mandate, after September 29, 1995, ODOT's current standard guard rail end terminal will **no longer be acceptable for installation** on the National Highway System (NHS). In order to conform to this requirement ODOT has, with FHWA approval, adopted the "Slotted Rail Terminal (SRT)" as manufactured by Syro, Inc. as its standard guard rail end terminal. The SRT should be specified on projects currently in design. After September 29, 1995 the SRT should also be installed on projects, under contract, that were designed with our old standard guard rail terminal. Also guard rail terminals that are heavily damaged and require replacement by maintenance should be replaced with the SRT.

The SRT is available in 2 designs:

- SRT-100 This terminal will be used to terminate guard rail on the majority of projects. The SRT-100 has the same 37'6" (11.430 m) end parabola with a 4' (1200 mm) offset as does our current guard rail terminal. As with our current end treatment, when required, the offset (W) will be increased to 8.1' (2450 mm) by using a transition parabola and 15:1 taper.

- SRT-75 This terminal is acceptable for use on roadways with speeds of 45 MPH (75 km/h) or less where a 4' (1200 mm) offset cannot be obtained. The SRT-75 is designed with an 18" (450 mm) offset and is 25' (7.620 m) in length. The SRT-100 should be specified if the 4' (1200 mm) offset can be obtained.

To specify the SRT on the plans, add the following note to the guard rail notes:

"Install SRT-____ End Terminal - (# req'd)."

As noted in the special provisions below, the item "SRT-_____" is full payment for the total length of SRT including end piece, anchor, strut, soil tubes, posts, rail, slot guards and all necessary hardware to furnish and install the SRT.

Therefore, no separate note or item for anchor or end piece is required when an SRT is specified. Also, do not include the length of SRT in the guard rail bid item.

Include the following Special Provisions to Section 00810 in projects that contain the SRT.

00810.00 Scope

This work includes furnishing and installing guard rail terminals which shall be "Slotted Rail Terminals (SRT)" by Syro, Inc., unless otherwise specified.

00810.85 Guard Rail Terminals

Slotted rail terminals will be measured for payment on a unit basis per each by actual count of units in place as specified.

00810.90 Payment

(k) Slotted Rail Terminals SRT -_____ each.

Payment for "Slotted Rail Terminals" will be payment in full for furnishing and installing slotted rail terminals, including posts, anchors, slotted rails, slot guards, end pieces, struts, soil tubes, and all necessary appurtenances and hardware to complete the work as specified.

In Item (k) the type of slotted rail terminals will be inserted.

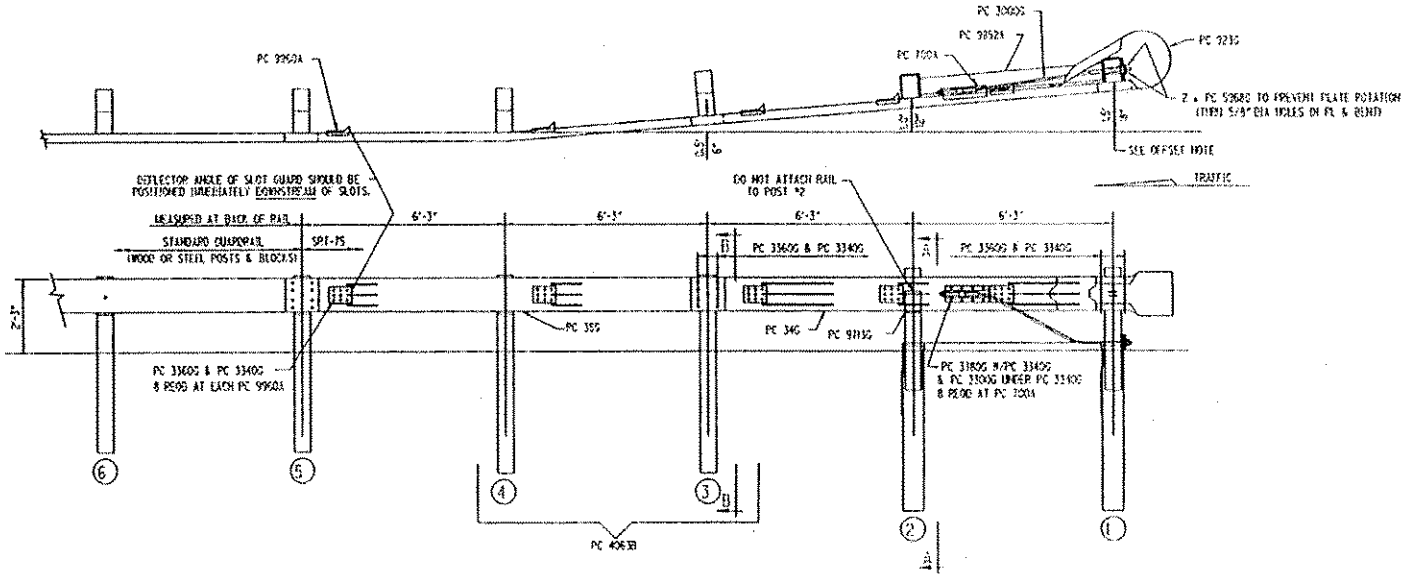
Attached for your information are two shop drawings and a photo of the SRT. Our Standard Drawings for guard rail are in the process of being modified to show SRT criteria. They will be distributed as soon as possible after being revised.

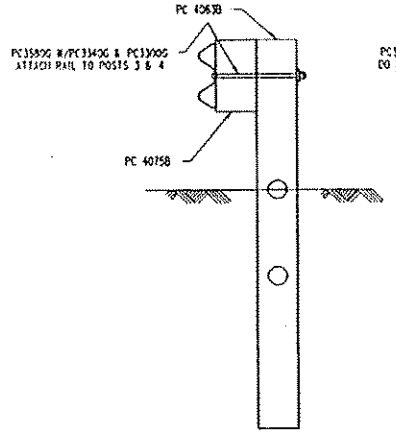
File under: Letters to Designers, Part 12, Guard Rail

SJ:jb

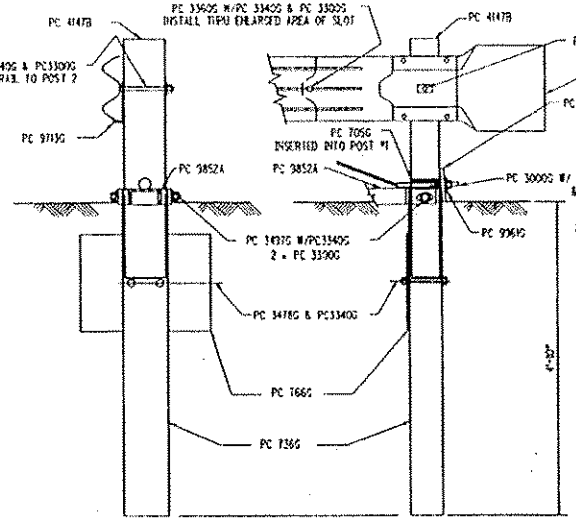
cc: Ken Stoneman w/attach
Terry Shike w/attach
John Grassman w/attach
Region Construction Engineers w/attach
Project Managers w/attach
District Maintenance Supervisors w/attach

OFFSET NOTE:
THE POST OFFSET DIMENSIONS ARE GIVEN TO THE CENTER OF THE TRAFFIC FACE OF THE BLOCKOUTS, EXCEPT AT THE FIRST TWO POSTS, WHERE THE DIMENSION IS TO THE CENTER OF THE TRAFFIC FACE OF THE POST. OFFSET POINTS ARE TO BE LOCATED BY CHORD MEASUREMENTS AT THE BACK OF THE RAIL EQUAL TO THE NOMINAL POST SPACINGS SHOWN. POSTS ARE TO BE SET APPROXIMATELY RADIAL TO THE RAILING AT EACH POST LOCATION.

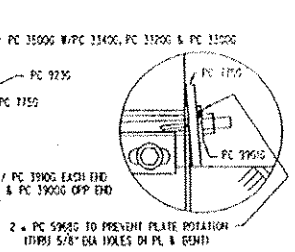




SECTION "B-B"
(- POSTS #3 & #4)



SECTION "A-A"
(- POST #2)



ENLARGED VIEW - POST #1

BILL OF MATERIAL

PC	QTY	DESCRIPTION
345	1	2/12'6/S SRT-1 (GUARDRAIL)
350	1	2/12'6/6'3/S SRT-2 (GUARDRAIL)
7100A	1	CABLE ANCHOR BRACKET
7350G	1	2'0" x 5/16" PIPE
736G	2	5'0 TUBE SLEEVE
766G	2	7/8" 18 x 24 SOIL PLATE
775G	1	5/8 x 6 x 8 BEARING PLATE
9230	1	12/BARRIER/98" (1 REQUIRED)
9900G	1	1/2" 6'6 CABLE
3300G	16	5/8" WASHER
3320G	1	3/16 x 1 1/2" 3 WASHER
3340G	70	5/8" HEX NUT
3360G	55	5/8"D x 1 1/4" SPLICE BOLT
3380G	8	5/8"D x 1 1/4" HEX HD BOLT
3478G	4	5/8"D x 1 3/4" HEX HD BOLT
3497G	2	5/8"D x 9" HEX HD BOLT
3500G	1	5/8"D x 10" POST BOLT
3580G	2	5/8"D x 18" POST BOLT
3900G	1	1" WASHER
3380G	2	1" HEX NUT
4063G	2	6'0 POST 6 x 8
4075B	2	1'6" BLOCK 6 x 8
4147G	2	3'9 POST 5 1/2" x 7 1/2"
5968G	2	10d HEAD SPT
9810G	1	SHIELD ANGLE
9852A	1	SHIELD ASSEMBLY
9960G	5	SLOT GUARD
9966G	1	5/8 x 3 x 4 PLATE WASHER

REV.	DWG	BY	DATE	REMARKS

SRT-75

SLOTTED RAIL TERMINAL (SRT-75)
POST LAYOUT AND ERECTION DETAILS

DRAWN B. TAYLOR
CHECKED
APPROVED
CUSTOMER P.O. No.
DATE 3-1-96
ENG FILE # SRT75
SHT No. 1 OF 1
DRAWING No. SS 485 REV 0

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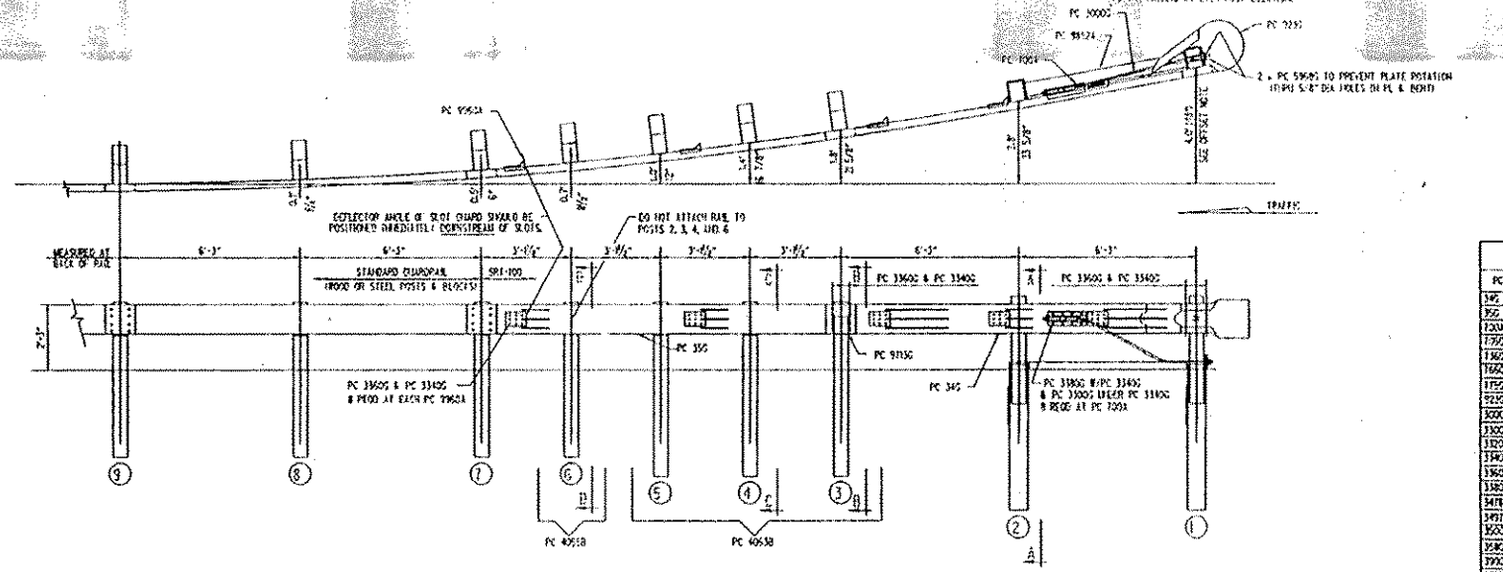
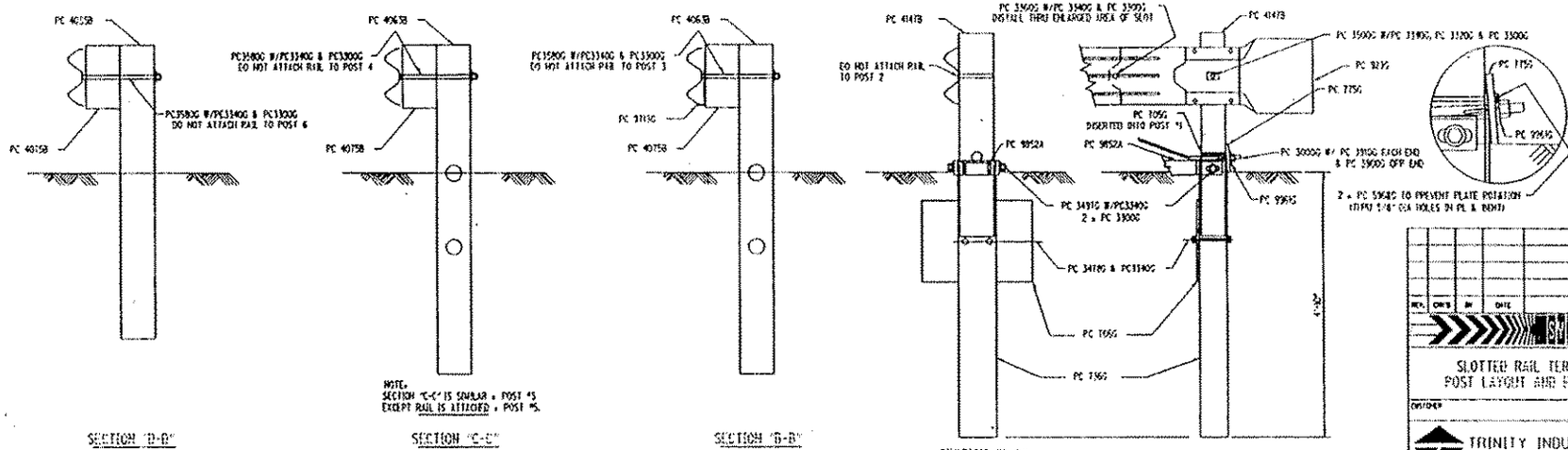
TRINITY INDUSTRIES, INC.
DALLAS, TX CHANNELVIEW, TX GRAND PRAIRIE, TX LIVONIA, LA FORT WORTH, TX (LEASED FACILITY)

OFFSET NOTE:
THE POST OFFSET DIMENSIONS ARE GIVEN TO THE CENTER OF THE TRAFFIC FACE OF THE BLOCKOUTS, EXCEPT AT THE FIRST TWO POSTS, WHERE THE DIMENSION IS TO THE CENTER OF THE TRAFFIC FACE OF THE POST. OFFSET POINTS ARE TO BE LOCATED BY CHORD MEASUREMENTS AT THE BACK OF THE BLOCKOUTS TO THE TANGENT POST SPACINGS SHOWN. POSTS ARE TO BE SET APPROXIMATELY RADIAL TO THE ROADWAY AT EACH POST LOCATION.



BILL OF MATERIAL		
PC	QTY	DESCRIPTION
345	1	2/12'6/5 SRT-1(GUARDRAIL)
355	1	2/12'6/6 3/5 SRT-2 (GUARDRAIL)
1200A	1	CABLE ANCHOR BRACKET
1795	1	3'0 x 5½" PIPE
1960S	2	5'0 TUBE SLEEVE
1968S	2	¾x 14 x 24 SOIL PLATE
1755	1	5/8 x 6 x 8 BEARING PLATE
9215S	1	12/BARRIER/56" TERMINALS
30000S	1	¾x 6'6 CABLE
33000S	18	5/8" WASHER
33200S	1	3/16 x 3½ x 3 WASHER
33400S	72	5/8" HEX NUT
33600S	63	5/8"D x 9¾" SPLICE BOLT
33680S	8	5/8"D x 8½" HEX HD BOLT
34178S	4	5/8"D x 10½" HEX HD BOLT
34197S	2	5/8"D x 11½" HEX HD BOLT
36005S	1	5/8"D x 10" POST BOLT
36805S	4	5/8"D x 18" POST BOLT
39000S	1	1" WASHER
39905S	2	1" HEX NUT
40058	1	5'4 POST 6 x 8
40658	3	6'0 POST 6 x 8
40758	4	14" BLOCK 6 x 8
41478	2	3'8 POST 5½ x 7¾
57968S	2	96d HOG, SRT
9715S	1	SHELF ANGLE
9952A	1	STRUT ASSEMBLY
9960A	5	SLOT GUARD
9969S	1	5/8 x 3 x 4 PLATE WASHER



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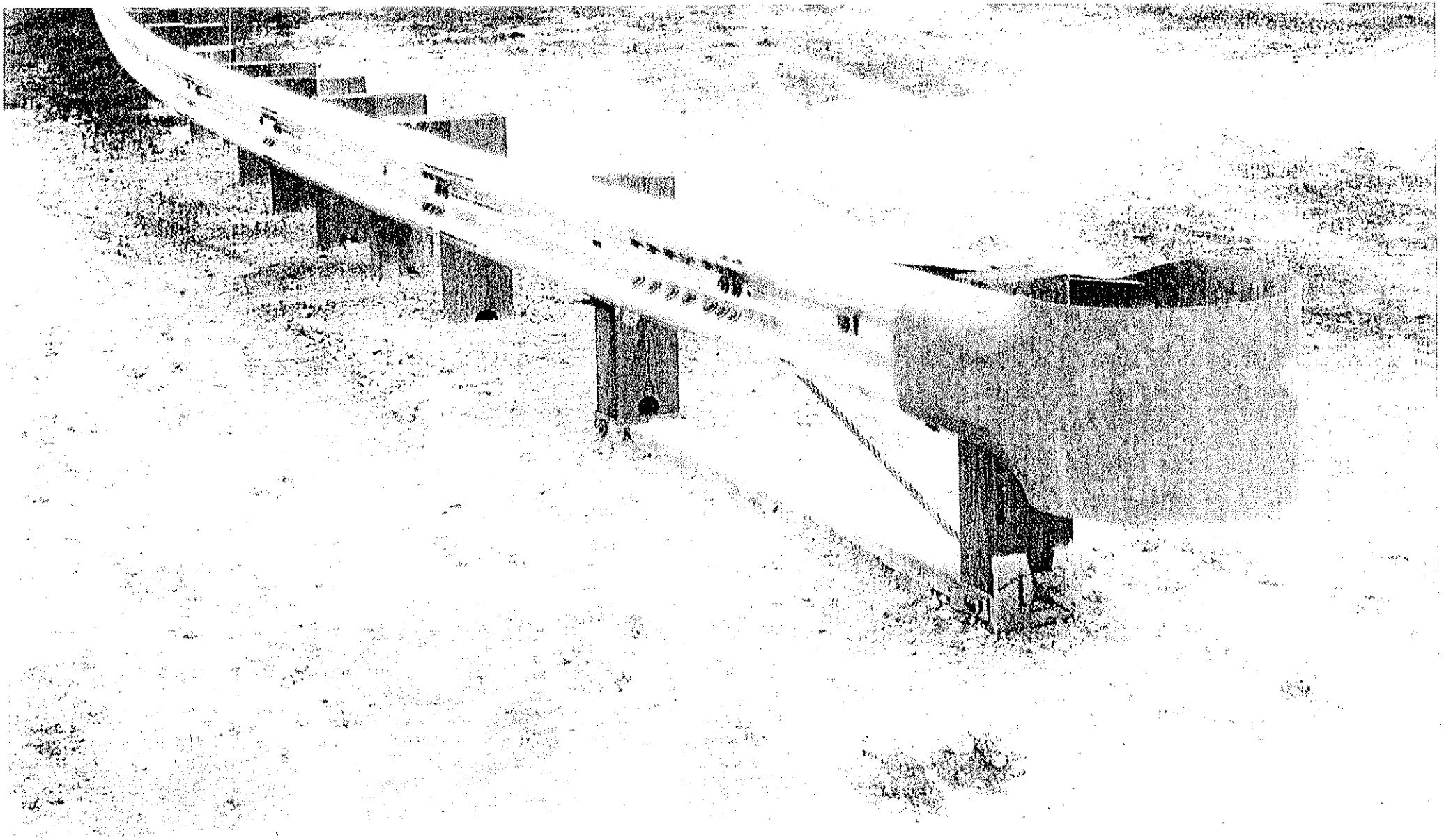
NO.	CHK'D	BY	DATE	REMARKS

SRT-100

SLOTTED RAIL TERMINAL (SRT-100)
POST LAYOUT AND ERECTION DETAILS

DRAWN	R. TAKACH
CHECKED	
APPROVED	
CUSTOMER	P.O. No.
DATE	3-1-05
ENG. FILE #	SRT100S
SHT. No.	8 OF 8
DRAWING No.	SS 402
REV.	0

TRINITY INDUSTRIES, INC
DALLAS, TX CORPUS CHRISTI, TX LIVINGSTON, CA LEMOLOY, OH FORT WORTH, TX ELIZABETHTOWN, KY



STATE OF OREGON INTEROFFICE MEMO

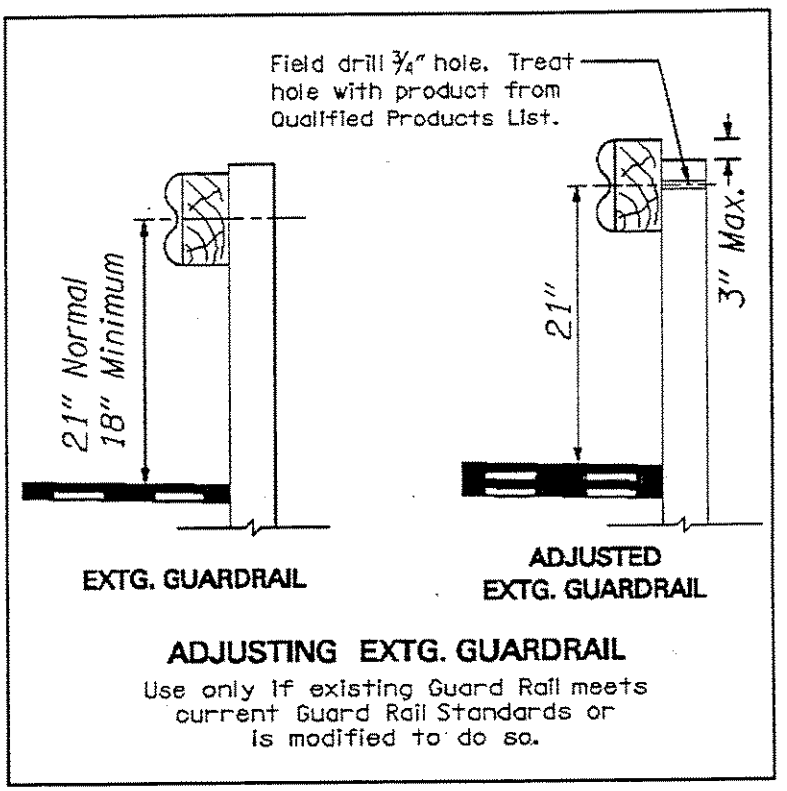
TO: Roadway Design Supervisors, Roadway Designers and Specifications

DATE: October 14, 1992

FROM: Sam Johnston,
Standards Engineer

SUBJECT: **Adjusting Existing Guardrail**

The State of Maryland has received approval from FHWA for a procedure to adjust existing guardrail installations. The detail below shows an acceptable method for raising existing guardrail after pavement overlays. Note that some existing guardrail posts may need to be raised and/or replaced prior to adjusting the rail. This should be noted on the plans and a method of payment for this work should be included in the contract.



ADJUSTING EXTG. GUARDRAIL

Use only if existing Guard Rail meets current Guard Rail Standards or is modified to do so.

FILE UNDER: Letters to Designers, Part 12, Guardrail

CC Jack Sullivan — Project Managers
Tom Edwards — Region Construction Engineers
Wayne Cobine — District Maintenance Supervisors
Terry Shike

ROADWAY SECTION DES

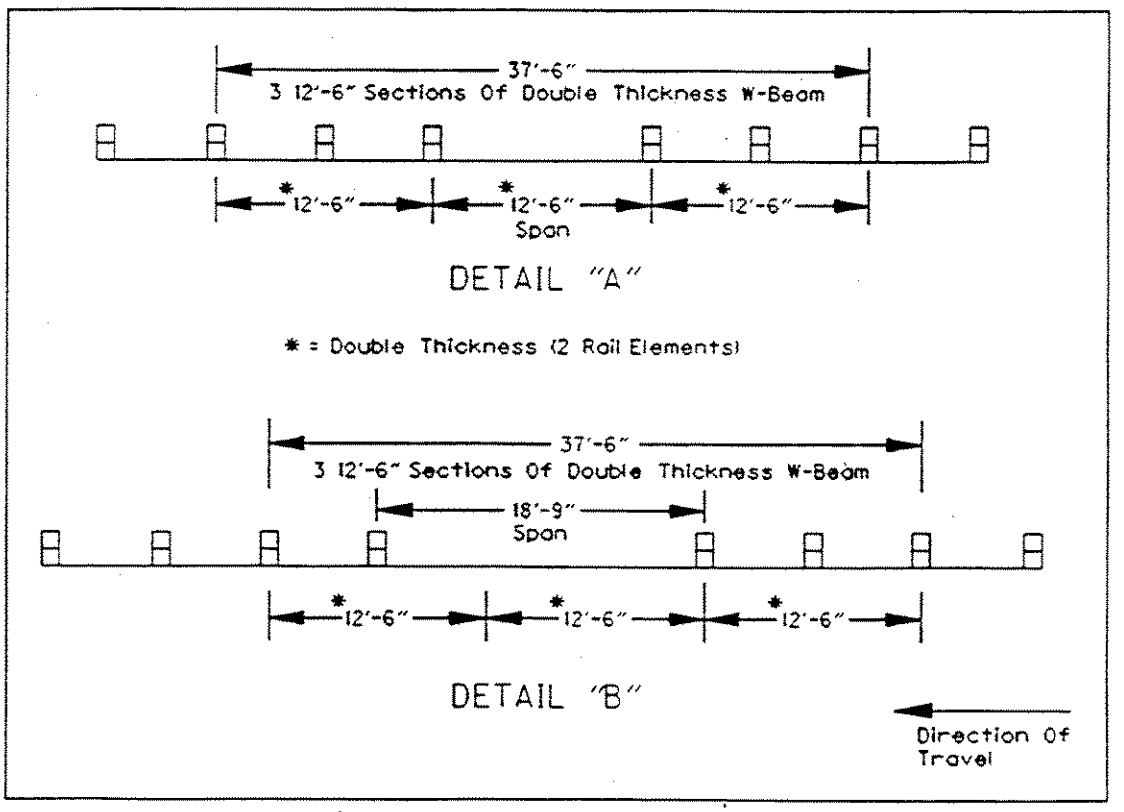
TO: Roadway Design Supervisors, Roadway Designers & Specifications

DATE: December 6, 1991

FROM: Sam Johnston
Standards Engineer

SUBJECT: 'W' Beam Guardrail Over Low-Fill Culverts

FHWA has recently approved a Washington DOT design proposal for continuing guardrail across a low-fill culvert or other obstruction. Detail 'A', shown below, is an acceptable method for continuing guardrail over areas where a 12'- 6" guardrail span, that contains no posts, is necessary. Detail 'B', shown below, is an acceptable method for continuing guardrail over areas where a 18'- 9" guardrail span, that contains no posts, is necessary. Contact the Standards Engineer for additional information.



FILE UNDER: Letters To Designers, Part 12, Guardrail

cc: Jack Sullivan
Terry Shike
Project Managers
Wayne Cobine
Region Construction Engineers

12

STATE OF OREGON
ROADWAY SECTION

INTEROFFICE MEMO

TO: Design Supervisors
Designers

DATE: December 20, 1989

FROM: David Greenberg
David Greenberg
Standards Engineer

SUBJECT: Guardrail "Length of Need"

In a recent Roadside Design Guide Workshop it was noted that length of need calculations are not always being made by all designers for guardrail or barrier.

The method to calculate length of need contained in the AASHTO, "Roadside Design Guide" should be used whenever guardrail or barrier is proposed on future projects. This will assure that the fixed objects within the clear zone are shielded as intended.

DG:jv

Section 12.

STATE OF OREGON
ROAD DESIGN SECTION

INTEROFFICE MEMO

DES 16

TO: Designers
Final Design Unit

DATE: March 30, 1988

FROM: Wayne F. Cobine
Final Design Engineer

SUBJECT: Radius Rail

Recently there has been some confusion on whether or not we should show the radius dimension on the plans for radius rail used at approach roads.

Researching the issue, I find a letter from Don Adams (dated 10/26/82) about the same issue. That letter is still appropriate, and it states that plans will show the guard rail bent (on a radius), and the standard drawing 2126A informs the contractor and Project Manager that a pre-curved rail element will be required for radii of 150' or less (5' minimum).

WFC:jr

cc: Tom Edwards

STATE OF OREGON
ROAD DESIGN-HIGHWAY

INTEROFFICE MEMO
DES 23-8

TO: DESIGNERS

DATE: January 21, 1985

FROM: Richard A. Kuehn, P.E.
Final Design Engineer

SUBJECT: Guard Rail Guide
Gore Areas
5' Radius "Bullnose" Detail

The attached revised detail replaces the existing, distributed to you July 19, 1984.

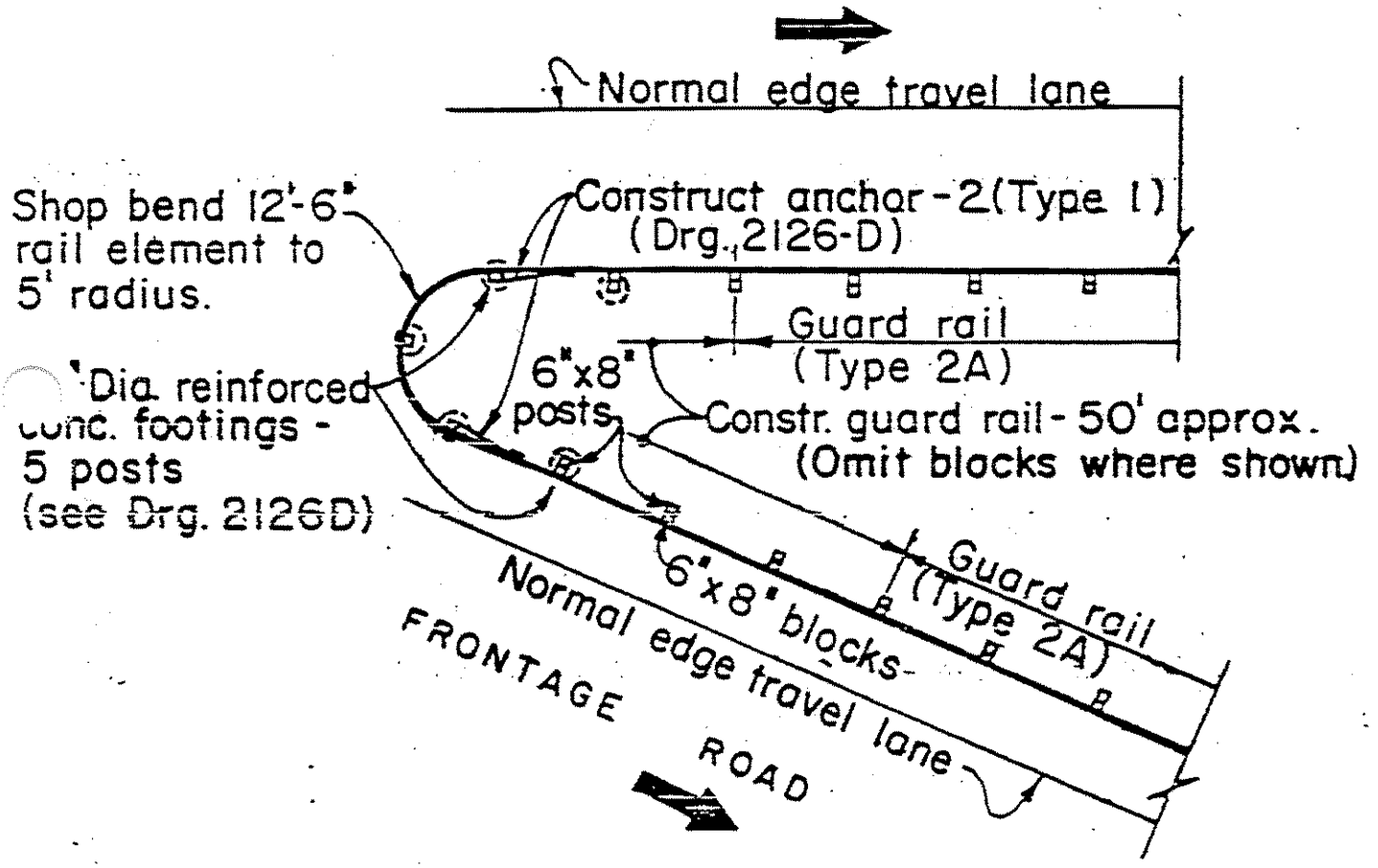
The revision adds blocks to the last two posts with concrete anchors. The three posts constituting the "bullnose" itself are to remain unblocked.

The purpose of the blocks is to reduce the possibility of snagging an errant vehicle which impacts the rail past the "bullnose" feature.

The remainder of the July 19, 1984 memo will remain in effect.

RK:DB:mg

GUARD RAIL INSTALLATION DETAIL



STATE OF OREGON
ROAD DESIGN SECTION

INTEROFFICE MEMO
DES 23-8

TO: MEMO TO FINAL DESIGN STAFF

DATE: October 26, 1982

FROM: Donald R. Adams
Final Design Engineer

SUBJECT: Guardrail Radii

I have received comments from the field that guardrail radius bends are not being indicated on the plans and that contractors are requesting additional payment to make the bends.

On our regular contracts where the guardrail is shown on a set of plans, the plans and standard drawings should adequately indicate to the contractor and the engineer the need for radius bends on the guardrail. The plan shows the guardrail bent and the Standard Drawing No. 2126A indicates "For guardrail installed on radii of 150 feet or less (5-foot minimum) use rail elements pre-curved to industry standards."

On some overlay projects where guardrail replacement is called for or additional guardrail is installed as directed by a table, guardrail curvature needs to be indicated. I presume it is this latter condition that causes the problem for Project Managers.

Where radius bends are not called for in the field-submitted data, we should request it. Missing field data should be specifically requested on the several overlay project shelf jobs. Please review the need for curved guardrail sections on current and future projects so the requirement can be detailed for contract.

DRA:ja

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